*REMARKS/ARGUMENTS*

*The Pending Claims*

Claims 1 and 3-38 are currently are pending and are directed to a hybrid structural module.

*Amendments to the Claims*

The claims have been amended to point out more particularly and claim more distinctly the invention. In particular, the claims have been amended to specify that the tubular fiber composite member is pultruded as previously recited by claim 2 (now canceled). Additionally, the claims have been amended to recite that the steel member is a steel bar, threaded rod, or tendon (cable) as previously recited by claim 24. Accordingly, no new matter has been added by way of these amendments.

*Summary of the Office Action*

The Office rejects claims 1-22, 24-27, 29-33 and 36-38 under 35 U.S.C. § 103(a) as allegedly obvious over U.S. Patent 3,810,337 (Pollard) in view of U.S. Patent 6,123,485 (Mirmiran et al.) and U.S. Patent 5,508,072 (Andersen et al.). Claims 1 and 28 are rejected under 35 U.S.C. § 103(a) as allegedly obvious over U.S. Patent 5,253,458 (Christian) in view of Mirmiran et al., Pollard, and Andersen et al. The Office rejects claim 23 under 35 U.S.C. § 103(a) as allegedly obvious over Mirmiran et al., Pollard, and Andersen et al., in further view of U.S. Patent 5,952,053 (Colby). Claims 34 and 35 are rejected under 35 U.S.C. § 103(a) as allegedly obvious over Pollard, Mirmiran et al., and Andersen et al., in further view of U.S. Patent 2,925,831 (Welty et al.).

Reconsideration of these rejections is hereby requested.

*Discussion of Rejections*

For subject matter defined by a claim to be considered obvious, the Office must demonstrate that the differences between the claimed subject matter and the prior art "are such that the subject matter as a whole would have been obvious at the time the invention

was made to a person having ordinary skill in the art to which said subject matter pertains." 35 U.S.C. § 103(a); see also *Graham v. John Deere Co.*, 383 U.S. 1, 148 U.S.P.Q. 459 (1966). The ultimate determination of whether an invention is or is not obvious is based on certain factual inquiries including: (1) the scope and content of the prior art, (2) the level of ordinary skill in the prior art, (3) the differences between the claimed invention and the prior art, and (4) objective evidence of nonobviousness. *Graham*, 383 U.S. at 17-18, 148 U.S.P.Q. at 467.

Consideration of the aforementioned *Graham* factors here indicates that the present invention, as defined by the pending claims, is unobvious in view of the cited references.

*1. Scope and Content of the Prior Art*

As regards the scope and content of the prior art, Pollard discloses a structural member in which reinforcing members (30) and (32) are surrounded by a lightweight void-containing material (38) (see, e.g., Figure 3). Pollard discloses that the lightweight void-containing material, in its final condition, adheres and bonds to the inner surfaces of side (10 and 12), bottom (14), and top (16) skin sheets (see, e.g., column 2, lines 45-47). The lightweight void-containing material is injected into the structural member as a liquid foamable mass such that after foaming the interlocks (18) of the skin sheets are further secured by a thin film of plastic "glue" (see column 2, lines 47-52).

The Office alleges that Mirmiran et al. discloses a fiber composite tubular member with reinforcing members and a cured substance. The structural member disclosed in Mirmiran et al. has a fiber reinforced plastic composite exterior shell, a cement core, and interior protruding fiber reinforced plastic portions. While Miriam et al. discloses pultrusion with respect to the interior protruding fiber reinforced plastic portions, Miriam et al. does not disclose that the exterior shell of the member is pultruded.

Christian discloses simulated logs which are PVC pipes filled with foam insulation that is formed around a steel beam. The foam insulation may be either a dilite or bead type foam (see, e.g., column 3, lines 37-38), and foam does not constitute a filled resin system.

Andersen et al. allegedly discloses a polyurethane panel with light and heavy aggregates. The disclosure of Andersen et al. is directed to the technology of containers, such as fast food containers (see, e.g., abstract and column 1, lines 42-49). In particular, Andersen et al. discloses dispersing aggregates in organic binders such as, polysaccharides, proteins and synthetic organic binders including polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinyl acrylic acids, polyvinyl acrylic salts, polyacrylimides, ethylene oxide polymers, polylactic acid, and latex. As such, Andersen et al. merely discloses light and heavy aggregates that may be mixed with packaging materials such as paper, paperboard, plastic, and polystyrene.

Colby discloses a process for producing filled polyurethane elastomers. The polyurethane compositions disclosed in Colby additionally may comprise diluents, compatibilizers, thixotropes, pigments, and anti-settling agents (see, e.g., column 4, lines 33-35).

The disclosure of Welty et al. relates to the fabrication of composite surfaces and structures. Welty et al. discloses that a clean and roughened substrate surface is necessary in the fabrication process in order to ensure the best results (see, e.g., column 3, lines 23-35).

*2. Level of Ordinary Skill in the Art*

For the purposes of the present argument, one of ordinary skill in the art can be treated as someone with an advanced degree and/or at least a few years of experience in a field relevant to the invention.

*3. Differences Between Claimed Invention and Prior Art*

The present invention is directed to a hybrid structural module, as defined by amended independent claim 1, and a method of forming the same, as defined by amended independent claim 33. Specifically, the hybrid structural module recited in the pending claims comprises:

(1) a pultruded tubular fibre composite member;

(2) a filled resin system located within the pultruded tubular fibre composite member; and

(3) at least one elongated steel bar, threaded rod, or tendon (cable) located within the filled resin system; wherein the filled resin system binds the steel bar, threaded rod, or tendon (cable) and pultruded tubular member together.

The Office maintains that the terms "pultruded" and "prestressed" in claims 1, 32, and 33, as amended, do not provide any structural limitation to the tubular fibre composite member or steel bar, threaded rod, or tendon (cable). Applicants reiterate that these terms should be properly construed as structural limitations and not as process limitations. Quite simply, a skilled person can place a pultruded member next to an extruded member and point to the pultruded member on the basis of the structural differences. The same is true for the pre-stressed steel member. The claimed limitations of "prestressed" and "pultruded" are physical characteristics that are inherent in the product and are not process limitations. An analogy may be drawn to the term "riveted." In this respect, two components may be joined together in a method of riveting. However, once joined the components are "riveted," and such a structural limitation carries patentable weight. Accordingly, the terms "pultruded" and "pre-stressed" constitute structural limitations of the claimed product.

Pollard discloses a structural member in which reinforcing members (30) and (32) are surrounded by a lightweight void-containing material, which in its final condition adheres and bonds to the inner surfaces of side (10 and 12), bottom (14) and top (16) skin sheets. Pollard does not disclose or suggest a pultruded tubular fibre member or a filled resin system. Rather, Pollard discloses a *void-containing* core that is distinct from a filled resin system. Specifically, the void-containing core disclosed in Pollard is not able to achieve the same structural properties of the filled resin system recited in the pending claims, such as increase in overall load carrying capacity, improved anti-crack behaviour, and decreased creep, as discussed in more detail below.

According to Pollard, the tensioning or stressing of the reinforcing members is through an end cap at each end of the beam (see, e.g., column 2, lines 42-45). In contrast, force transfer from the steel bars in the hybrid structural module recited in the pending claims is through the filled resin system and occurs along the total length of the element. The structural differences between the inventive structural module recited in the pending claims and the structural element disclosed in Pollard are easily demonstrated by cutting the

structural elements in half (lengthwise). When Pollard's element is cut in half, it ceases to function as a structural element because the steel bars are no longer anchored at two ends and, therefore, can no longer be stressed. A "lightweight void containing core" is unable to transfer any significant force between the steel bars and the skin. In contrast, the hybrid structural module recited in the pending claims can be cut into two or more pieces lengthwise, and each piece will continue to function as a hybrid module due to its continuous force transfer along its length.

The structural member disclosed in Mirmiran et al. has a fiber reinforced plastic composite exterior shell, a cement core, and interior protruding fiber reinforced plastic portions. The disclosure of Mirmiran et al. is directed solely to the use of a concrete composite structure having a cement core. In contrast, the invention recited in the pending claims comprises a filled resin system located within the pultruded tubular fibre composite member which binds the elongated steel bar, threaded rod, or tendon (cable) and pultruded tubular fibre composite member together, which, importantly, makes the steel bar, threaded rod, or tendon (cable) and the tubular fiber composite member work together as one structural unit. While Miriam et al. discusses pultrusion with respect to the interior protruding fiber reinforced plastic portions, Miriam et al. does not disclose that the exterior shell of the member is pultruded, as required by the amended claims. Moreover, the figures of Mirmiran clearly show the exterior shell 12 and plastic portions 14, 16 to be separate components. Using pultrusion to manufacture the multilayered shell 12 would not be viable.

The main function of the composite wrap disclosed in Mirmiran et al. is to provide a water proof shell, while at the same time adding confinement to the concrete core (see, e.g., column 1, lines 61-63, and column 6, lines 26-33). Confinement increases the load carrying capacity of concrete in compression, bending, and shear (not tension). A concrete column loaded in compression wants to expand in cross sectional direction due to Poisson's action. By preventing or restraining this cross sectional expansion, the column is put in a three dimensional state of compressive stress and is able to carry more load. However, if the column is loaded in tension, the cross section gets smaller, and the fiber composite wrap ceases to work.

Because bending and shear are both accompanied by compression, the system disclosed in Mirmiran et al. also works partly in those cases. However, the composite wrap has hardly any effect in pure tension. Therefore, an additional significant difference between the structural member disclosed in Mirmiran et al. and the invention recited in the pending claims is that the structural member disclosed in Mirmiran et al. does not work as well in tension as in compression.

In addition, the structural member of Mirmiran et al. has significant disadvantages when loaded in tension, because, without prestressing, concrete loaded in tension will crack. In contrast, a filled resin system, as is present in the inventive structural module, has excellent tensile properties and can be loaded in tension as well as compression.

Christian discloses PVC pipes filled with foam insulation that is formed around a steel beam. The foam insulation may be either a dilite or bead type foam (Christian at column 3, lines 37-38). The Office alleges that the combined disclosures of Pollard and Mirmiran et al. compensate for the deficiencies of Christian. However, as discussed above, neither Pollard nor Mirmiran et al. discloses a hybrid structural module comprising a pultruded tubular fiber composite member or a filled resin system located within such a hybrid structural module.

Instead, the result of the combination of Pollard, Mirmiran et al., and Christian would be an exterior filament wound shell surrounding insulating foam and a steel beam, a PVC pipe surrounding concrete and protruding fibers, or a PVC pipe surrounding a void-containing core and reinforcing members. Clearly, these combinations are distinct from the invention defined by the amended claims and would not achieve the secondary considerations and advantages thereof (discussed further below).

Similar to Pollard, Mirmiran et al., and Christian, Andersen et al. also does not disclose or suggest a hybrid structural module comprising a pultruded tubular fiber composite member or a filled resin system located within such a hybrid structural module, as recited in the amended claims. In contrast to the amended claims, Andersen et al. is directed to the distinctly different technology of containers, such as fast food containers (abstract and column 1, lines 42-49), and merely discloses light and heavy aggregates that may be mixed with packaging materials, such as paper, paperboard, plastic, and polystyrene.

Andersen et al. teaches dispersing aggregates in organic binders, such as polysaccharides, proteins, and synthetic organic binders including polyvinyl pyrrolidone, polyethylene glycol, polyvinyl alcohol, polyvinylmethyl ether, polyacrylic acids, polyacrylic acid salts, polyvinyl acrylic acids, polyvinyl acrylic salts, polyacrylimides, ethylene oxide polymers, polylactic acid, and latex. These binders clearly are distinct from the resin systems disclosed in the present application.

Furthermore, the sheet materials disclosed in Andersen et al. will readily degrade into a fine granular powder when exposed to moisture, pressure, and other environmental forces (see column 10, lines 22-32). Therefore, the sheet materials disclosed in Andersen et al. could not be used in the manufacture of a hybrid structural module, which must resist the aforementioned types of forces in order to provide a reliable structural building material.

For the foregoing reasons, it is clear that the disclosures of Pollard, Mirmiran et al., Andersen et al., and Christian, alone or in combination, do not disclose or suggest all of the limitations of independent claims 1 and 33.

The Office relies on Colby as allegedly disclosing the addition of a thixotrope to a resin. Similarly, the Office relies on Welty et al. as allegedly disclosing cleaning and roughening a structural member. Neither Colby not Welty et al. discloses or suggests a hybrid structural module comprising a pultruded tubular fibre composite member, as recited in the pending claims. Accordingly, the disclosures of Colby and Welty et al. do not compensate for the deficiencies of the other cited references.

In summary, the invention defined by the amended claims comprises a hybrid structural module comprising a pultruded tubular fibre composite member and a filled resin system located therein, which is readily distinguishable from the void-containing materials, foams, and polymers disclosed in the references cited by the Office.

*4. Objective Evidence of Unobviousness*

The invention recited in the pending claims combines three primary elements: a pultruded tubular fiber composite member, a filled resin system located therein, and an elongated steel bar, threaded rod, or tendon (cable), each of which has a different failure

behavior. This novel and inventive combination advantageously builds redundancy into the hybrid structural element. As a result, it is extremely unlikely that the three components of the claimed module will fail at the same time (see the specification at page 8, lines 11-17). Additionally, if one of the three components develops a crack, the crack is unlikely to extend into the other components. This is because cracks have a tendency to follow the interface of different materials, rather than travelling straight through them (see the specification at page 8, lines 18-22).

Importantly, as recited in independent claims 1 and 33, the filled resin system binds the steel bar, threaded rod, or tendon (cable), and the pultruded tubular fiber member together. This has the advantage of making the steel bar and the pultruded tubular fiber composite member work together as one structural unit. As a result, the invention recited in claims 1 and 33, and claims depending thereon, is a synergistic hybrid member in which the overall load carrying capacity is surprisingly more than the mere sum of the individual members.

Applicant has unexpectedly discovered the synergistic increase in overall load carrying capacity, improved anti-crack behavior, and decreased creep of the hybrid structural module recited in the pending claims. In view of the potential for catastrophe if a structural element fails, the increased overall load carrying capacity of the invention defined by the amended claims is of great advantage and has the potential to avoid collapse of buildings and dwellings which might otherwise place many lives at risk.

There is nothing in the cited references which would have reasonably suggested to one of ordinary skill in the art that the physical features that define the present invention, especially the three primary elements discussed above, would impart the aforementioned superior properties to a hybrid structural module.

*5. Consideration of Graham Factors Together*

As set forth above, the invention recited by the amended claims requires a pultruded tubular fiber composite member and a filled resin system located therein, which is not disclosed or suggested by any of the cited references, either alone or in combination. Therefore, even when the disclosures of Pollard, Mirmiran et al., Christian, Andersen et al., Colby, and Welty et al. are considered together, there is no disclosure of all of the features of

the present invention. Instead, a combination of elements taught by the prior art would result in an inferior structural module that lacks the advantageous properties of the invention recited in the pending claims. In view of this deficiency, the invention recited in the pending claims is clearly not the result of combining known elements to achieve a known result. Moreover, the Office provides no credible reason for one of ordinary skill in the art to modify the structural module resulting from following the combined teachings of the cited references in the manner necessary to provide the inventive structural module. Accordingly, the present invention, as defined by the pending claims, must be considered unobvious in view of the cited references, such that the rejection under Section 103(a) should be withdrawn.

Applicants further note that the European Patent Office (EPO) has indicated in the course of the prosecution of the counterpart European patent application that the subject matter of the pending claims of the present application is both novel and unobvious. In particular, the EPO has stated: "The combination of all the features of claims 1, 2 and 24 is neither known from, nor rendered obvious by, the available prior art ...." (EPO Official Communication dated October 21, 2009, sheet 3, item 3 (copy attached)). This is precisely the combination of features recited in the pending claims, as amended herein, of the present application.

*Conclusion*

Applicants respectfully submit that the patent application is in condition for allowance. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

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